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ELECTRIC LIGHTING IN THE CITY.

THE most extensive trial of the electric light for public purposes yet made will, about the 1st of February next, be inaugurated in the City of London, as the City Commission of Sewers have adopted a report of the Streets Committee recommending that the tenders of the Anglo-American Light Company, of the Electric and Magnetic Company, and of Messrs. Siemens Brothers be accepted. The first company will undertake the lighting of Blackfriars Bridge, Bridge Street, Ludgate Hill, St. Paul's Churchyard, and Cheapside to King Street, by the Brush system, at a cost of £1,410 for 12 months. The second company will light Southwark Bridge, Queen Victoria Street, and Queen Street, by the Jablochkoff system, the cost being £2,930 for 12 months. Lastly, Messrs. Siemens will light London Bridge, Cheapside (from King Street, Mansion House Street, and King William Street), at a cost of £3,720 for the 12 months.

On a rough calculation, taking all the districts together, the cost (including the plant, machinery, fixing and replacing, &c.), will be about four times the price now paid for gas-lighting; but eliminating those expenses, which would not be recurring, the cost would be only twice that of gas, while the amount of light produced will be very much greater.

Messrs. Siemens are the only contractors who propose to bury the conductors wholly underground. There can be little doubt but that the latter is the proper course to adopt. Open conductors slung from lamp to lamp, or post to post, are very unsightly in broad daylight, as any one walking along the Thames Embankment can testify. If any system is permanently employed, underground wires will certainly have to be used, and we think the Commissioners should have insisted upon this course being followed in accepting any of the contracts.

A great deal has been said about the relative values of a large number of small lights compared with a small number of large lights: the coming trial will severely test this question, as the number of electric lights will be very much less than the number of gas jets they are to displace; thus, although there may be a brilliant illumination at points, the intermediate spaces will possibly be wanting in light. According to the tenders, 449 gas lights will be replaced by 116 electric lights, or roughly, 1 electric light will take the place of 4 gas lights, so that the space between each electric light will be four times that between each gas lamp. In order, therefore, that the intermediate points between each electric lamp may be illuminated to the same extent as was the case when the gas lamps existed, the intensity of the illumination from each electric lamp will have to be correspondingly great, it being recollected that the intensity of a light diminishes as the square of the distance it is from the object it illuminates. In other words, the light from each electric lamp will require to be sixteen times as great as that given by the gas jets. There are, of course, other considerations which come into play, and which practically modify the theoretical calculation, but the importance of estimating lighting power by space illuminated and not by candle-power cannot be too strongly urged.

THE HYDROSTATIC TELEGRAPH.

By MAURICE GIRARD.

CERTAIN of our streams and rivers have excessive rises, so sudden that they cannot be announced to the borderers in time sufficiently early to enable preparations to be made for avoiding the same. Thus at Toulouse, in 1876, the prodigious mass of water of the Garonne, which without notice inundated the lower part of the town, came from a very long distance, when it suddenly submerged the unfortunate Faubourg St. Cyprian; it had rolled forward for more than twenty hours, and it had spread over more than forty-five leagues over a country well provided with telegraphs. However, it was not announced in any way when it reached Toulouse, where it swallowed up hundreds of human lives and did enormous damage.

It is to avoid such a terrible event that M. C. Gros, of Rodez, has sought to solve the following problem: To keep the borderers *continually* informed of the state of the river as regards its rises, so that precautions may be taken in time to avoid the danger. It was necessary that the apparatus should fulfil certain conditions of economy in order that its employment should be practical. It must, by the variation of the level of the water, set in motion the telegraphic system without the intervention of watchers by day or night, the exactitude of which can be relied upon. Besides, it is necessary that the notice be transmitted to the ordinary telegraph offices so that there is no need of a supplementary supervision, and that the notices can be addressed direct to the borderers or to those interested by the most rapid means of public communications.

The Gros telegraph is composed of three distinct parts: 1st, the transmitter; 2nd, the receiver; 3rd, the wires which connect the two.

The transmitter (fig. 1) is composed of a float, a battery, and a set of oscillating pendulums. The float is a hollow cylinder 50 decimetres in circumference, furnished with a cable, C, C_1, which makes a turn over a pulley, *a*, to which it transmits the movements of the water level. The series of pendulums, *d d d d* - - - - - *d d d d* (fig. 2), suspended to a pivot, *c*, are actuated by the wheel, *a*, and turn to the right or left according as the float rises or falls. In the first case the pendulums send out a positive current to line, L, and a negative to earth; the reverse movement of the wheel, *a*, makes, on the contrary, a negative current to pass to line and a positive to earth. It can be seen, therefore, that this automatic action caused by the water sends out to line a positive or negative current of short duration, according as the water rises or falls. At the station the receiver, by means of a pointer and dial,

indicates automatically the currents sent, and if the rise of the water is very sudden rings a bell. This receiver (figs. 3 and 4) is simply a double Breguet receiver with certain modifications: 1st, the two driving trains, placed symmetrically, are driven in the reverse direction the one to the other; 2nd, the electro-magnets connected to each clockwork movement are polarised, the one positively and the other negatively; 3rd, there is a single dial; 4th, between the two last wheels, R, R, of the clockwork trains (fig. 4) an intermediate wheel, O, is set, which is geared into by one of the two wheels, R, R, the teeth of the latter being so shaped relatively to the teeth of the wheel, O, that the gearing only takes place when one or other of the two wheels turns. As long as the one or other of the movements is allowed to work by the action of the current, the one or other of the two wheels, *r r'* (the one behind the other), which are on the same axis, is caused to turn. The gearing of each of these two last wheels, *r r'*, is such that, driven by the ratchet-wheel, R, it is without action on the other.

The movements of the wheel, O, are limited by a special regulator. This wheel, O, carries a needle, which moves round a graduated dial, and which indicates the height of the water each time that the level of the water changes, whether it be a rise or fall, a distance of 10 centimetres. The same wheel, O, transmits its movements to a horizontal clip, which slides between fixed guides, and which carries a soft pencil. In contact with this pencil moves, over a roller, a strip of paper, this strip being moved along by means of a clock. The pencil thus traces, without interruption, the exact curve showing the rise or fall of the water. In case of a sudden rise, when the needle is at a point marked *Danger*, a bell

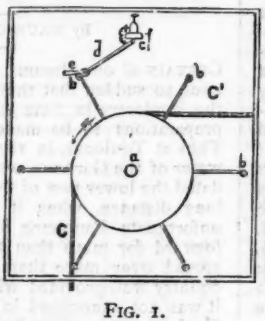


FIG. 1.

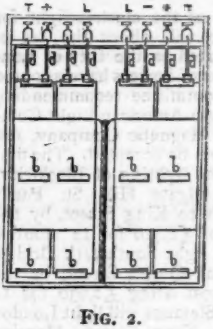


FIG. 2.

FIGS. 1 and 2.

Figs. 1 and 2, transmitter; *a*, grooved pulley-wheel; *b*, conducting rods fixed to insulated supports; *c*, axis of pendulums; *d*, pendulum rods; *e*, jointed tongue of pendulums; *f*, terminals; L, line wire; T, earth wire; +, positive pole; —, negative pole.

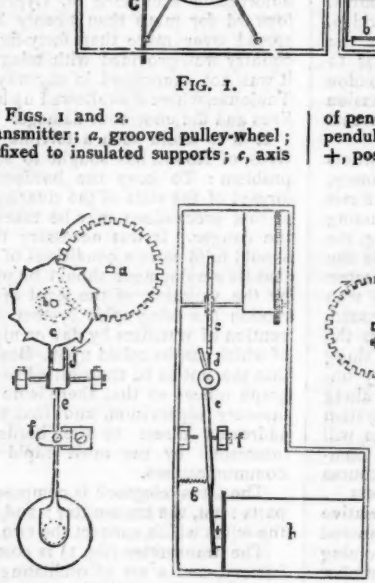


FIG. 3.

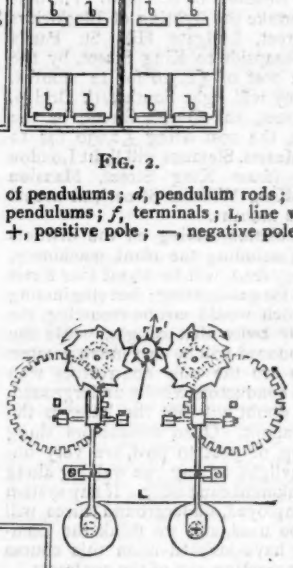


FIG. 4.

FIGS. 3 and 4.

a, driving clockwork; *b*, pinion; *c*, ratchet-wheel; *d*, escapement fork; *e*, lever; *f*, stop; *g*, spring; *h*, electro-magnet; O, axis of needle carrying two wheels, *r r'*—these wheels, *r r'*, are set one behind the other R R, ratchet-wheels turning in opposite directions and regulated by the escapement forks, *d*; L, line wire passing round both electro-magnets.

sounds, either by day or night, and calls the attention of any one who may be near the receiver; a single glance at the dial allows of the height of the water and the degree of danger to be at once seen. A single wire between the receiver and transmitter communicates the indications.

It is easy to understand the advantages of the apparatus of M. Camille Gros. Science is benefited, as the daily observations can be automatically registered, and a mathematical curve of the changes is obtained. The other systems, and particularly the telephone, cannot give this important result. The employé may be occupied or even asleep, the electric-bell announces at once the danger, and the alarm can be spread. Better still, the dial can be placed out of doors; any one can then read from it as easily as from a barometer or clock. By comparing the indications with the information given by a table placed by the side of the instrument, the rapidity of the advance of the water can be known by reason of its volume, each borderer can therefore know at what time the inundation will arrive at his locality. The Gros apparatus thus becomes a true meteorological instrument analagous to those which have been so usefully placed for some time in our towns in order to indicate storm disturbances, and not less useful.

After the description of this hydrostatic telegraph made by the engineer of the Vital mines before the Société des Lettres, Sciences et Arts of l'Aveyron, and on the unanimous recommendation of this Society, the Conseil-Général of l'Aveyron granted the funds for the construction of a first specimen of the system. Experiments took place, at the expense of the State, on the Lot, between Penelot and Capdenac, a distance of 14 kilometres between the transmitter and receiver. They worked perfectly, and it is to be wished that the higher administration will make a statement to this effect.—*La Nature*.

NEW ELECTRIC LAMPS.

GORDON'S ELECTRIC LAMP.

THE inventor has for his object improvements in apparatus for producing electric light. For this purpose he avails himself of a discovery announced by Mr. Spottiswoode, that an induction coil can be excited by a De Méritens or other dynamo-electric machine giving alternate currents, and that in this case no contact breaker or primary condenser is required. To apply this discovery to electric lighting he so modifies the secondary terminals that a light fit for illuminating purposes can be obtained from the secondary discharge. He uses coils of moderate size, and places a number of them on the circuit of the machine, either in parallel circuit or in series, or in a combination of the two.

The inventor breaks the secondary circuit in one or in several places, getting a light at each, so that all the lights or any one coil are in series. Terminals of platinum or other refractory metal are used, and the general form consists of a lump of platinum supported on a thin platinum wire. These lumps become white hot, and the thin stems prevent the heat from being conducted away. A mechanical arrangement is adopted which brings the lumps nearly together (or connects them by a wire or other conductor) when the current is not flowing in the primary coil, and separates them to a short distance when the current commences. The supports of the terminals should be mounted on some soft substance and the lights inclosed in globes, in order to extinguish the noise that otherwise occurs. The advantages of the system, *as claimed*, are, that a great number of lights can be worked from one dynamo-machine, that no carbon or *anything else* is consumed in the lamp, and that the light is perfectly steady and no clockwork is used.

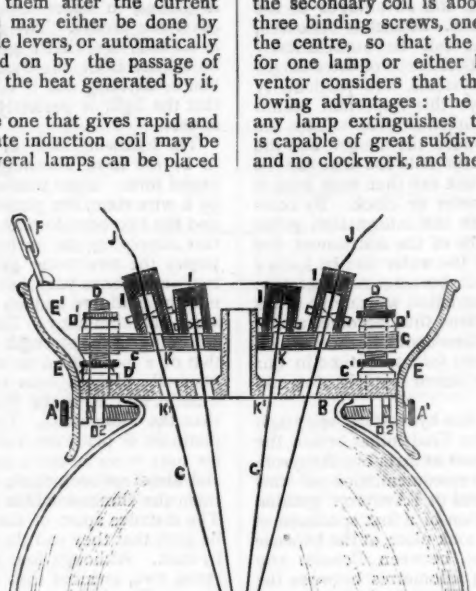
The following form of the lamp has been found to be the most advantageous, but is not the only useful form. Four pear-shaped knobs, each carried by a wire stem, are placed in a line near together, and the two outside ones connected to the conductors supplying the currents. When the discharge passes the two outer get moderately hot and the two inner ones very hot. The two outer knobs may be platinum and the two inner ones iridium or iridio-platinum alloy. The size of the knobs varies according to the strength of the current, from about that of a pin's head to that of a small pea. It is generally advantageous to make all four knobs of iridium, and to make the two outer ones smaller than the inner ones. The stems are preferably of platinum or platinum-iridium alloy, and the inventor uses wires about 2 to 3 inches long or more, and about ·06 inch thick, the object being to have them the thinnest which will be safe from melting. The distance apart of the knobs when cold should be such that they just do not touch when expanded by heat. Although four knobs are commonly used, three, two, or more than four may be used in some cases. The drawing shows a section of an electric lamp of this kind. A is a glass globe held by screws, A^1, to the underside of a plate, B, of glass or porcelain. C is a plate of ebonite carried by brass pillars, D, from the plate, B. D^1 are nuts screwing on to the pillars, D, and holding the plates. D^2 is a cross head on the lower end of each pillar; the screws, A^1, screw through these heads. E is an opaque shade by which the plates, B and C, may be surrounded. E^1 are arms fixed to the plate, B; by these arms the lamp can be suspended by chains, F. G are four stems of platinum wire with knobs, H, of iridium, on their lower ends. The upper ends of the wire stems are fixed to the caps or solid tops of tubes, I, which are carried by the ebonite plate, C. The two outermost wire stems are coupled by wires, J, to the source of the rapidly alternating currents of the electricity. The suspenders can, if desired, be used as conductors. Through the sides of each of the tubes, I, are screwed three adjusting screws; the ends of the screws bear against the wire stems, and by means of them the knobs at the lower ends of the stems can be held and retained at any required distance apart from one another. There are holes, K, in the plates, B and C, through which the wire stems, G, pass. These holes also serve to admit currents of cool air to the interior of the globe, A. A chimney is provided by which heated air can rise up and escape from the globe.

It is found that much greater tension is required to light the lamps, *i.e.*, to cause the spark to spring between the cold knobs, than to maintain them when lighted. Now, although it is perfectly pos-

sible to produce a current of sufficiently high tension, either by a machine or by an induction coil, to light the lamp, yet it is found that as every increase of tension throws an extra strain on the insulation, it is advantageous to bring the four knobs into contact, or nearly into contact, before the lamp is lighted, and to separate them after the current has begun to pass. This may either be done by hand, by the use of suitable levers, or automatically by a lever or levers acted on by the passage of the electric current, or by the heat generated by it, or otherwise.

The machine should be one that gives rapid and sharp reversals. A separate induction coil may be used for each lamp, or several lamps can be placed on one coil as follows: they may be all placed in series, or a better plan is to let each lamp have its own section of the secondary wire. This latter plan makes all the lamps in a coil nearly independent of each other.

The lamps may be lighted and extinguished either by a make and break key in the secondary circuit or by short-circuiting the secondary. Or the lamps may be lighted and extinguished by shunting the primary current on and off the coil, or on and off several coils at once, with or without the introduction of a compensating resistance. To give some idea of the dimensions of the coils the inventor gives the details of one which he has used for one 100 candle lights or two 50 candle lights. The primary consists of a bundle of iron wires 1·3 inch in diameter and 18 inches long. Three layers of insulated wire ·08 inch in diameter are wound on it. The secondary is wound on an insulating tube, and consists of about ¾ mile of wire, ·0075 inch diameter, covered four times with silk. It is wound in 60 discs. The external diameter of the secondary coil is about 3·5 inches. There are three binding screws, one at each end and one in the centre, so that the whole coil can be used for one lamp or either half separately. The inventor considers that the new light has the following advantages: the accidental destruction of any lamp extinguishes that lamp only, the light is capable of great subdivision, there is no vacuum and no clockwork, and the light is extremely steady.



THE PHOTOPHONE.

By SHELFORD BIDWELL.

OUR contemporary *Nature* publishes the following:—Many readers of NATURE will doubtless be glad to know that Mr. Graham Bell's extraordinary experiments may be repeated on a small scale with very simple apparatus, no special appliances being required beyond the mirror transmitter and the selenium receiver, both of which may be easily constructed. I propose to give a short description of an arrangement which has in my hands been very successful.

The mirror is made of the thin mica which is sold

by opticians for covering *carte de visite* photographs. It is cut by scissors into a circle 2¼ inches in diameter, and silvered by the process for silvering glass specula. The box in which it is mounted is an ordinary wood turned box 2½ inches in diameter. A circular hole of about 2 inches diameter is cut in the lid, behind which the mirror is laid with the reflecting side outwards, a flat ring of vulcanised india-rubber of suitable size and thickness being placed behind the mirror; when the box is closed the ring should hold the mirror firmly in position. If the lid screws on, so much the better. At the bottom of the box is cut a hole, into which is glued one end of a flexible speaking-tube 18 inches long, having at its other end a wooden mouthpiece. It will be found convenient to attach a short wooden arm to the box in a direction perpendicular to its axis. By means of this arm the transmitter may be held in a clamp in any desired position. This completes the transmitter as described by Mr. Bell. I have made a small addition which, though not essential, is a decided improvement. At the back of the mirror I cemented a disc of calico 1 inch in diameter, in the centre of which had been previously inserted a loop of silk half an inch long. A hole ⅛ inch diameter is bored perpendicularly in the side of the box at a point about ½ inch from the mirror end of it, and in this hole is inserted a piece of watch-spring 1⅜ inch long, with its flat sides parallel to the top and bottom of the box. The spring is fixed into the hole with wooden plugs so that one end is flush with the outer surface of the box; the other end where it intersects the axis is bent into a shallow hook. Into this hook is slipped the silken loop, and the tension of the spring draws the mirror into a slightly concave form, and seems to make it respond more perfectly to sound vibrations.

By far the most important part of the whole apparatus is the selenium "cell." After making some dozens of different forms, most of which were more or less sensitive, but none satisfactory, I tried the one now to be described, which turned out very successful. Take a slip of mica 2¼ inches long and ¾ inch broad, and beginning at ¼ inch from one end, wind round it in the form of a flat screw some No. 40 copper wire. The pitch of the screw is $\frac{1}{16}$ inch, that is, each wire on the two faces of the mica is $\frac{1}{16}$ inch from its neighbours. Continue winding up to ¼ inch from the other extremity; then fix the two ends of the wire by passing them through holes drilled in the mica. Now take a second wire and carefully wind this on beside the other, thus forming a second screw, the threads of which are midway between those of the original one. Fix this as before. Great care must be taken that the two wires do not touch each other at any point: it will be well to make sure of this by testing with a galvanometer before proceeding further. If a lathe is at hand, the tedious operation of winding may be very greatly facilitated. Turn a cylinder of hard word 4½ inches long and 1 inch in diameter; cut this cylinder longitudinally into two equal parts, and between the two semi-cylinders thus formed place, sandwich-like, a slip of mica of equal breadth. Secure the ends with screws. Smooth down the whole in the lathe, and when the edges of the mica are quite flush with the surface of the wood, cut upon the cylinder a screw of 32 threads to the inch. On removing the mica from the cylinder its two edges will be found to be beautifully and regularly notched. Wind the first wire into alternate notches, and the second into the others. The wire should be annealed to take away its springiness and make it lie flat, and the mica should be stout enough to bear tight winding without buckling.

For the succeeding operation a retort-stand at least 15 inches high is convenient. Fix one ring 15 inches above the foot; on a lower ring stand a medium-sized Bunsen burner. On the top ring lay a flat sheet of brass $\frac{1}{16}$ inch thick, and on the brass a piece of mica (to save waste selenium). Place the embryo cell on the mica, laying small weights on its two ends to keep it steady and bring it into closer contact. Having brought the Bunsen burner close under the brass, melt a few grains of vitreous selenium in a small spoon and let four or five drops fall upon different parts of the cell. Spread the melted selenium evenly over the surface with a slip of mica, pressing it well between the wires. During this process the temperature must be carefully regulated by raising or depressing the burner. If it is not high enough, the selenium will begin to crystallise; if too high, the selenium will gather up into drops, being apparently repelled from the surface of the cell. The temperature should in fact be just above the fusing point of crystalline selenium. When a smooth surface is obtained, quickly remove the cell with microscope forceps and let it cool. Its surface will now be smooth and lustrous.

The cell must next be annealed. And here my experience differs in a remarkable manner from that of Mr. Bell, as stated in his celebrated lecture. It is true that selenium may be rendered crystalline in "a few minutes," but in this condition I find it far less sensitive to light than after it has undergone a process of long heating and slow cooling. My method is as follows:—The brass plate being cool, lay the cell upon it again, and place the burner at its lowest possible point. The selenium will soon begin to crystallise, as evidenced by its surface assuming a dull leaden appearance. (If the crystallisation has not begun in five minutes, raise the burner an inch or two.) In from five to ten minutes the whole of the selenium should be crystallised. Then very gradually raise the burner until signs of fusion just begin to appear. This will probably take place when the flame is within 3 inches of the brass. Instantly remove the burner, and in about ten seconds re-crystallisation will occur. Now fix the burner ½ inch below the point at which it was when fusion commenced, and let it remain for four hours, merely looking at it from time to time to ascertain that, owing to increase of gas pressure or other causes, the heat has not become too great. After four hours begin the cooling by lowering the burner an inch or two, and repeat this operation every ten or fifteen minutes, until the burner is at its lowest point. Then slightly lower the gas-flame at short intervals, until it is finally extinguished. When the brass plate is quite cool the cell may be removed.

I may mention that I first made a cell of this form, which I believe to be original, on October 28.* If

* If a larger surface is desired, two or more of these cells may be placed together side by side, the ends of the wires being properly

the two wires were wound on a cylinder made of some suitable non-conductor (*e.g.*, slate) with a double screw cut upon its surface, a cell might be formed which, it appears to me, would unite all the advantages of Mr. Bell's with far greater simplicity.

My experiments were made with the transmitter and selenium cell above described, a magic-lantern with a 4 inch condenser, the focussing lenses being removed, two plano-convex lenses obtained by separating a 3½ inch condenser, a "blow-through" lime-light, a battery of eleven cells (small Leclanché's answers well), and a pair of Bell telephones. It is essential that the bobbins of the latter be wound with finer wire than that generally used. Mine contain No 40 (instead of 35 or 36), and I intend to try 42. Their diameter is also larger than usual—1¾ inch.

The transmitter is clamped so that its axis is inclined at an angle of about 30° to that of the lantern condenser, the centre of the mirror being 7 or 8 inches from the centre of the condenser; and the position of the lime-light is so adjusted that the condensed rays may just cover the whole surface of the mirror.

The reflected beam is rendered as nearly parallel as possible by one of the plano-convex lenses (this can only be done approximately), while the other, placed a foot or two away, concentrates the light upon the selenium cell, forming an elliptical image of the mirror. The major axis of the ellipse should be parallel to the length of the cell, and the minor axis slightly longer than its width. A great deal depends upon the focussing, and the best results have been obtained when the image of the mirror was not quite sharp. The selenium cell is joined in circuit with the battery and the pair of telephones, the latter being for obvious reasons placed in a distant room. The arrangements are now complete, and a person listening with a telephone applied to each ear will, if everything is right, plainly hear words which are spoken into the transmitter. When I first made the experiment I was so much astonished at the distinctness of the reproduction that I believed that one of the battery connections must be defective, thus acting like a microphone. This was disproved by screening the mirror, when all sound instantly ceased.

Though the articulation is not perfect, it is far better than I had expected, judging from the accounts of the performances of the photophone in Paris. A leading article might not be altogether intelligible, but ordinary colloquial phrases are readily understood. The loudness of the reproduced speech varies in an unaccountable manner. Sometimes the voice is rendered almost as loudly as in an ordinary telephone; at other times, under apparently the same conditions, it is scarcely audible. Alternations from loudness to faintness, and *vice versâ*, frequently occur in a single sentence.

The distances across which the beam is carried have varied in my experiments from 1 foot (when the two plano-convex lenses were in actual contact) to rather more than 4 feet. With a larger receiving lens this distance could be greatly extended, especially if the electric light were used.

For the "musical" effects produced by an interrupted beam I use a disc of zinc 1 foot in diameter, having eight radial slits cut in it, and mounted upon a vacuum tube rotator. The cell is placed 6 inches from the lantern condenser, and the disc made to rotate close before it. The sound produced is very loud, and can be heard when the telephones are at a distance of a foot or more from the ears.

It is very singular, that whereas I have been so successful in repeating Mr. Bell's more complex experiments, I have utterly failed in all attempts to produce sound by the simple incidence of an interrupted beam upon a thin diaphragm. I have experimented with discs of ebonite varying from $\frac{1}{64}$ to $\frac{1}{4}$ inch in thickness, and with several metals, and can only suppose that my source of light is not sufficiently powerful.

THE AMERICAN FAST SPEED AUTOMATIC TELEGRAPH.

SOME trials have recently been made on the Postal Telegraph wires of a fast speed automatic telegraph system, the invention of Mr. T. M. Foote, of Brooklyn, and F. Anderson, of Peekskill, America. Although on the longest circuits the system failed to attain the speed given by the Wheatstone instruments, yet on short circuits very high results were given, and the system therefore merits a description.

As in the Wheatstone instrument, the currents in the transmitting portion of the apparatus are controlled by a perforated slip of paper; the latter is shown by fig. 1.

A peculiarity in the system consists in the fact that each signal is formed by either one positive or one negative current, and that two currents of a like sign never immediately follow one another—that is to say, a positive current always follows a negative, and a negative a positive current.

The perforated slip is passed over a metallic roller, w (figs. 2 and 3), which is divided into two insulated halves, which are respectively connected to the zinc and copper poles of a split battery earthed in the middle. Two brushes, b, b^1, both connected to line, press on the two halves of the rollers and make contact with one or other half as they drop through the perforations in the paper slip when the latter is moved over the roller.

At the receiving end of the line a chemically prepared paper (as in the Bain system) passes under two metallic styles which press on the roller, w; one style being connected to line and the other to earth, as shown in fig. 3. According, therefore, as a positive or a negative current flows to line a mark is made on the upper surface of the paper by one style or the other.

Let us now suppose the slip represented by fig. 1 is turned round and passed from left to right over the roller, w, and under the brushes, b, b^1, then the brush, b, first drops through the first perforation and sends a short zinc current, which represents the first dot of the letter A. The brush, b^1, next drops through the first of the two perforations on the upper edge of the slip, fig. 1, and sends a short copper current to line, which is immediately followed by a second short copper current from the brush, b^1, making contact through the second per-

connected. The width of ¾ inch for a single cell cannot be much exceeded, because the expansion produced by the heat necessary for melting the selenium would make the wires on a wider surface so loose as to touch each other.

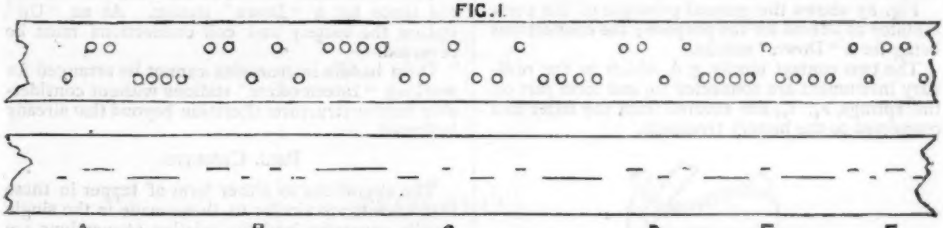
foration; two dots close together are thus formed, but the condenser, C (fig. 3), being charged by the current, discharges itself when the brush is passing over the small interval between the two dots, and this discharge current at the receiving end practically turns the two dots into a dash.

Inasmuch as the dash is not formed by a current left on for a lengthened period, but by two successive currents filled up between, as it were, the condition of the line when the brush leaves the second perforation is the same as it would be if the brush had only passed over a single perforation; thus, after a dash has been formed the line is perfectly clear to receive another signal. After the letter has been completed a dash formed by four perforations close together is produced, which spaces the letter from the succeeding letter.

Now, supposing that it were required to signal two letter A's one after the other, then if we look at the left-hand end of the perforated slip, fig. 1, we can see that if the relative positions of the dot and dash perforations were the same in both cases two distinct signals would have to be formed by similar currents immediately following one another, thus we should have two A's formed as follows:— . ‥ . . . . ‥ . If, however, we wish positive and negative currents to succeed one another alternately, we should require to have the perforations arranged as follows, . ‥ . . . . ‥ . ; in other words, we require to have the position of the perforations representing the second letter A reversed. Now, if all the letters were formed by an *odd* number of signals the reversals of the currents would always take place correctly, but inasmuch as some letters are formed by an even number of signals and some by an odd number, it would be necessary that the perforations representing these letters be reversed continually. The mechanism by which this end is effected is highly ingenious and effectual, though complicated. The perforations are made and arranged by means of mechanism actuated by a key-board similar to that of a Hughes type printer.

Although the system has not been entirely successful in this country, in America it has been worked to a speed of 1,500 words a minute, but this has been obtained with a circuit on an independent line of poles, and with a wire of a large gauge.

FIG. 1.



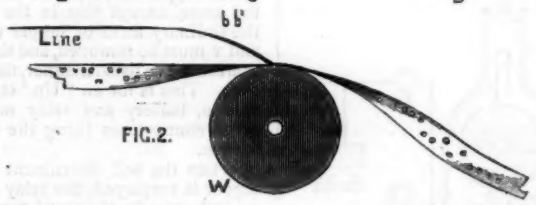
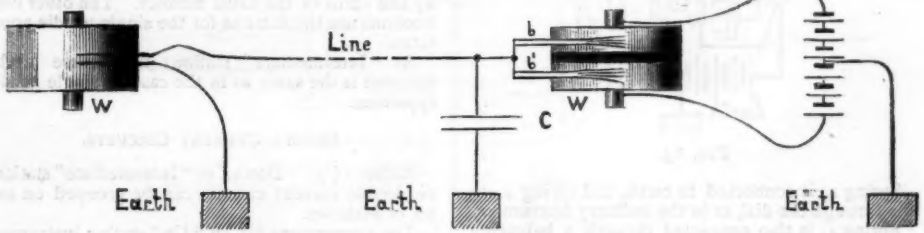


FIG. 2.

FIG. 3.



The Wheatstone apparatus in England, up to the present, has by no means been worked up to its greatest possible capacity; in fact, no attempts have been made to obtain a greater speed than 250 words a minute. With greater driving power and lighter moving parts a greatly increased speed is undoubtedly possible. The great advantage of the Wheatstone apparatus lies in the fact that in the transmitter, signals cannot be missed—that is to say, the perforated slip cannot move forward to cause a second contact until the mechanical action causing the first contact to be made has acted properly. Where a brush is used to make contacts there is a tendency for the former to jump across from one side of a perforation to the other, instead of dropping down between and making a firm contact.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXII.

THE UNIVERSAL BATTERY SYSTEM—(*continued*).

THE DROP HANDLE SINGLE NEEDLE INSTRUMENT.

ALTHOUGH Drop Handle Single Needle Instruments are never grouped on a universal battery in the Postal Telegraphic Service, since the number in use is very small, yet it is possible to arrange them so that they may be worked on the universal system.

Unlike other instruments the drop handle instrument to be arranged for universal working requires considerable structural alteration.

Fig. 83 shows the general principle of the commutator as altered for the purpose; the connections being for a "Down" station.

The two contact blocks, *g*, *h*, which in the ordinary instrument are connected to, and form part of, the springs, s_1, s_2, are severed from the latter and connected to the battery terminals.

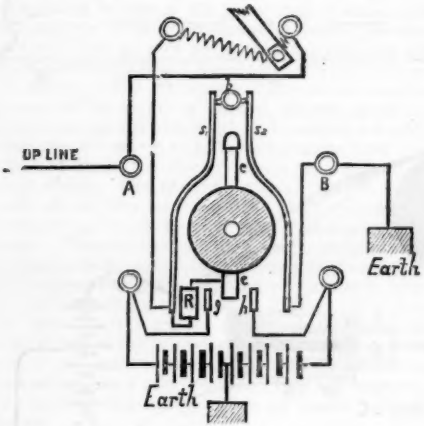


FIG. 83.

Spring s_2 is connected to earth, and spring s_1 to line through the dial, as in the ordinary instrument.

Spring s_1 is also connected through a balancing resistance, R, to the lower brass rod, *e*; if no balancing resistance is required, s_1 and *e* are connected direct.

The upper brass rod, *c*, is left free, no connection being made on to it.

The Copper pole of the battery is connected to *g*, and the Zinc pole to *h*.

Action of the Commutator.

The action of the apparatus is as follows:—

Supposing the cylinder to have a right-handed angular movement given to it by means of the handle, then the rod, *c*, presses against the spring, s_2, and moves the end of the latter away from the bridge, *b*; the Earth connected to terminal, B, is thus disconnected. On moving the cylinder still further round, the rod, *e*, touches the block, *g*, and thus the Copper pole of the battery becomes connected through the resistance, R, and the dial, to the line at terminal, A, and the middle of the battery being to earth, the left-hand half of the former sends a Copper current to line.

If the cylinder be turned in the opposite direction then earth is first taken off by the spring, s_1, being moved away from the bridge, *b*; and then the rod, *e*, comes in contact with the block, *h*, and puts the Zinc of the battery to line, and thus, since the middle of the whole battery is to earth, the right-hand half sends a Zinc current to line.

When the instrument is in its normal position, as shown by fig. 83, then the current of the line is complete through the dial, through spring s_1, through the bridge, *b*, and thence through spring s_2 to terminal B and earth.

The connections shown, as has been pointed out, are those for a "Down" station. At an "Up" station the battery and coil connections must be reversed.

Drop handle instruments cannot be arranged for working "Intermediate" stations without considerable further structural alteration beyond that already indicated.

BELL CIRCUITS.

The alterations to either form of tapper in these instruments are similar to those made in the single needle apparatus, and the relative connections are the same, except that in the bell instrument with the ordinary form of tapper the strap connecting X and Y must be removed, and the bell relay connected thereto in the usual manner, the line being connected to A. This is for an "Up" station. At a "Down" station, battery and relay must be reversed, the other connections being the same as for an "Up" station.

When the bell instrument with the bell form of tapper is employed, the relay is connected between A_1 and earth in the usual manner. The other connections are the same as for the single needle apparatus.

At "Intermediate" stations the course to be followed is the same as in the case of single needle apparatus.

DOUBLE CURRENT CIRCUITS.

Either "Up," "Down," or "Intermediate" stations on double current circuits can be grouped on one set of batteries.

The connections for an "Up" station instrument are shown by fig. 84. They are the same as for ordinary working, except that terminal 7 instead of being put to earth is disconnected.

At a "Down" station the line connection is the same as at an "Up" station, but the relay and battery connections are reversed.

The equalising resistances in either case are placed in the battery leads as shown.

The total number of cells required for terminal double current circuits worked from a universal battery is double that required for the circuit of highest resistance on the group previous to its conversion.

The connections for "Intermediate" instruments are shown by fig. 85.

The resistance, R, between terminal U or 6 of the relay, and terminal 7 of the key is required in cases

where the "Up" line is shorter, or, rather, less in resistance, than the "Down" line; its value should be such as to equalise the two.

As intermediate and terminal instruments can be grouped on the same battery, it must be recollected in calculating the values of the equalising resistances for the former that the resistance through which each half of the battery has to work is only half that of the entire line. Thus, for example, if a terminal instrument be worked on a line of 1,000 ohms resistance, this being the highest resistance of the group, then if an intermediate instrument be worked with the same group, and the resistances of the "Down" line and balanced (if necessary) "Up" line be each 700 ohms, then the levelling resistances in the battery leads would have to be 50 ohms; for 700 + 50 = 750, which is 25 per cent. less than 1,000 ohms, the resistance of the longest line.

The total number of cells required in the split battery for "Intermediate" instruments, when the "Up" and "Down" lines do not require to be equalised by a resistance, is the same as that required for ordinary working, since each half of the battery works one-half of the entire circuit. When, however, an equalising resistance is required, a proportionately increased power will be necessary. Thus, for example, suppose the "Down" line had a resistance of 1,000 ohms, and the "Up" line a resistance of 500 ohms, and suppose the battery required for working the circuit on the ordinary system was 50 cells, then we have to balance up the "Up" line by putting a resistance of 250 ohms between terminal U or 6 of the relay and terminal 7 of the key, so as to bring the resistance of the "Up" line to within 25 per cent. of the resistance of the "Down" line. Now originally the 50 cells had to work through a

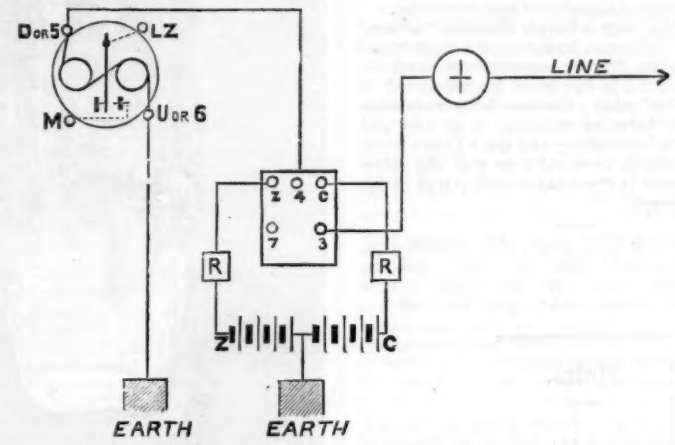


FIG. 84.

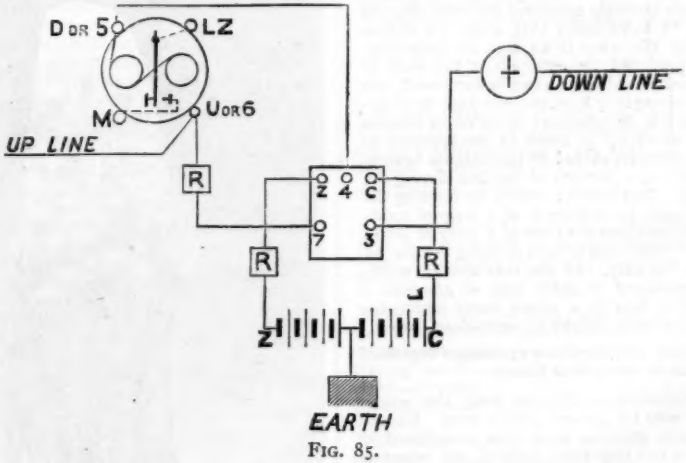


FIG. 85.

total resistance of 1,500 ohms, but now, practically, we may say, the actual resistance to be worked will be 1,750 ohms. Therefore, the number of cells will have to be increased in the proportion of 1,750 to 1,500, that is to say, we should require 50 × 1,750 ÷ 1,500 = 58·3, or say 60 cells. To work properly, therefore, the instrument should be grouped on a 60 cell universal battery.

It will be noticed that the equalising resistance is only in circuit when the station is *sending*, and therefore, the *received* signals are not weakened.

When the "Up" line is longer than the "Down" line, the "Up" line must be connected to terminal 3 of the key; the battery connections must be reversed; terminal 4 of key must be connected to terminal U or 6 of relay; the equalising resistance must be placed between terminal 7 of key and terminal D or 5 of the relay; and the "Down" line must be connected to terminal D or 5 of the relay. The battery power is the same as that stated in the preceding paragraph.

ERRATA.—Article XXI., page 388; bottom line, left-hand column, read "right" for "left"; 3rd line, right-hand column, read "left" for "right"; 22nd line, right-hand column, read "right" for "left."

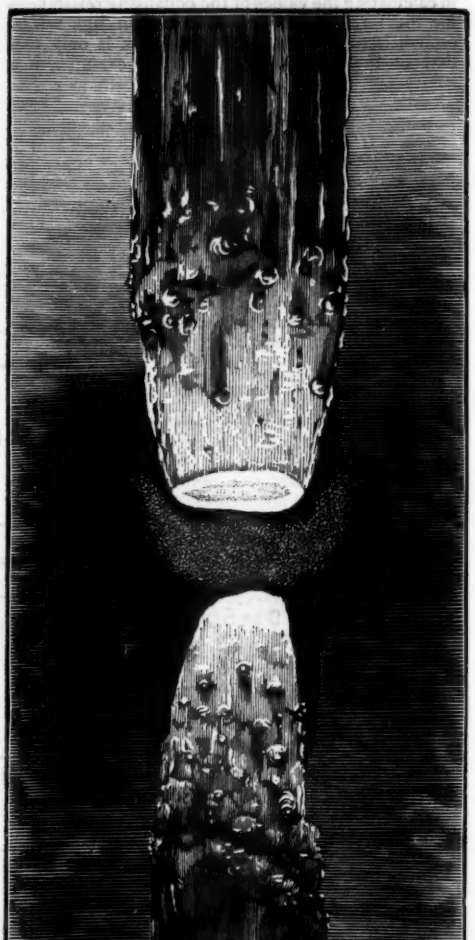
Notes.

WITH reference to Mr. Swan's paper on his new electric lamp, read before the Society of Telegraph Engineers, we give the following extract from the patent, which may throw some light upon the nature of the remarkable material employed for producing the illumination:—"I have found that when the carbon employed within the lamp is an arch or horseshoe-shaped plate, produced by cutting out the arch or horseshoe-shaped piece from a sheet of cardboard, and afterward carbonising it by heat, that the arch or horseshoe-shaped carbon so produced is liable to become distorted and ultimately to break in consequence of the unequal contraction caused by the unequal heating of the inner and outer portions of the arch during the use of the lamp. This defect I remedy by forming the carbon to be made incandescent of a strip of cardboard or paper bent into the form of a hoop or loop; the front view of such hoop or loop showing the section or thickness of the strip, and the side view its width. *The strip of cardboard or paper bent as aforesaid I subject to a white heat in a closed vessel containing powdered carbon or other suitable air-excluding powder.*"

THERE are now 318 telephone exchanges organised and in operation in the United States.

POLICE TELEPHONES.—Chicago leads the way in adopting telephones for general police uses. Experimental telephonic stations have been established at various points in one important district, and relays of mounted officers are kept in waiting at a central station. Reliable citizens are furnished with keys to the telephone boxes nearest their residence. To prevent false alarms the keys are numbered, and cannot be withdrawn from the lock until released by a key carried by the policeman on that beat. When anything goes wrong in a district the alarm is sent to the central station, and explanations are given through the telephone. In case of serious disturbance a large bell is sounded, and every officer on post runs to the nearest box to receive orders.—*Scientific American.*

THE BRUSH ELECTRIC LIGHT.—A powerful electric light on the Brush system was recently exhibited at the workshops of the Anglo-American Electric Light Company, in Vine Street, Lambeth. The intensity of the illumination was, from the single lamp, equal to several



thousand candles, and unusually large carbons were employed for the purpose. Through the courtesy of Mr. W. Ladd we are able to illustrate the actual carbons employed in the experiments. The figure represents the electrodes in full size, in the form assumed when traversed by the electric arc.

FIRE CAUSED BY AN ELECTRIC LIGHT WIRE.—Mr. Jas. Harrison, Superintendent Bureau of Surveys, New York Board of Fire Underwriters, writes the following letter to the *Scientific American*:—"I venture to call your attention to an occurrence which took place at No. 4, Maiden-lane very recently. In the office of Messrs. Silcox & Co., No. 4, Maiden-lane, is a telephone communicating with their factory, No. 14, Maiden-lane. One day, either Monday or Tuesday last, some person on the roof of one of the intervening buildings dropped an *electric light* wire upon that of the *telephone* wire of Messrs. Silcox, bringing the two wires in contact. The effect rather astonished the people in the office. Flames burst forth from the telephone instrument on the wall, producing such an intense heat as to entirely destroy the magnets." Although doubt has been expressed as to the accuracy of this statement, such an accident is quite possible.

MR. SPOTTISWOODE, president of the Royal Society, was present at the sitting of the French Academy of Sciences on the 15th inst. He witnessed experiments made at Méritens' workshop on the magneto-electric engines which have been ordered by the Trinity House. The trials were successful.—*Nature*.

ON the night of the 3rd inst. a magnificent display of aurora was seen from various parts of the country. We have received several communications on the subject. Mr. E. W. Prevost writes from Cirencester that the display was visible there from 6 p.m. up to about midnight. "The glow, which extended over an angle of about 100°, rose upwards to a height of 20°, leaving the central portion comparatively dark. Faint streamers occasionally showed themselves, reaching 35° in height. A shifting of the streamers from east to west was noticeable, the illuminated arc being at times extinguished on the eastern side, this extinction progressing slowly towards the centre of the arc, when the light would reappear at the eastern side. At no time, as far as I observed, did the light disappear on the western side; the colour was of a greenish-yellow and the wind due north." From Bootham, York, November 3rd, Mr. J. Edmund Clarke writes:—"There is quite a brilliant aurora this evening, first noticed about 6.30 as a diffused light shifting from north-east to south-west, with occasional streamers. Now (7.30-8.45 p.m.) it forms a low bright arch of considerable intensity. I said 'first seen about 6.30,' but at 4.40 I called the attention of a friend to some sharply-defined red streamers in the north-east, which I then took to be sunlight. On August 12th last, about ½ to ¾ hour after sunset, my attention was called to streamers precisely similar, in every respect like those of the aurora. But careful observation showed that these were certainly radiating *from* the sun, and not converging *towards* the magnetic pole. It is certainly my impression that such was the case to-night, but being busy I did not take any special pains to ascertain. Of course this double coincidence may be a pure accident, but is it not possible that the minute substances reflecting the solar rays are actually modified by the electric field, so as to produce this remarkably distinct variety of rays? P.S.—8 p.m. Brilliant streamers from the bright arch, with some corruscations." Prof. Reilly, of the Royal College of Science for Ireland, writes that in Dublin the display was very fine. "The principal beam appeared as if slowly moving from west to east, and had a direction quite parallel to the pointers of the Great Bear. It reached at the time when seen quite up to the Polar Star. The lights were observed at earlier hours, one person having mentioned to me 6 o'clock p.m."—*Nature*.

MR. C. HUTTMAN, of Vienna, has invented an electrical spur for the management of horses.

ARRANGEMENTS are being made to put the Cape Observatory into connection with that at Aden for astronomical purposes.

AN International Exhibition of Electrical Appliances is to be opened at Paris on the 1st August next, and will remain open until November 15th. M. Georges Berger has been appointed Commissioner-General of the Exhibition and also of the Congress to be held in connection with it.

NEW SUBSTITUTE FOR RUBBER.—This artificial composition, says the *English Mechanic*, which answers the purpose of genuine caoutchouc or gutta-percha, can be employed, according to Dankworth and Sanders, of St. Petersburg, either alone or in connection with other resinous substances. According to *Ackermann's Gewerbeseitung*, this new product affords an inexpensive means for a perfect isolation of wires for electrical purposes. The composition is elastic, tough, not so sensitive to external influences as caoutchouc or gutta-percha, and is not injured by high pressure or high temperature. It is prepared in the following manner:—A quantity of coal-tar oil, or equal parts of coal and wood-tar oil, which is to constitute a third part of the whole mixture, is poured into a large kettle, together with an equal quantity of hemp-oil, and is heated for several hours, either over steam or an open fire, to a temperature which lies between 252° and 288° Fah. (it should not exceed the latter), until the mass becomes so ductile that it can be drawn in long threads, and the remaining third, consisting of a quantity of linseed oil, which has been thickened by boiling, is then added. With this composition from 5 to 10 per cent. of ozokerite and some spermaceti should be mixed. The mass is then heated again for some hours at the same temperature as above, and finally from 7 to 12 per cent. of sulphur are added. The mixture thus obtained is cast into forms and treated the same as caoutchouc. The proportion of the three oils may be slightly varied according to the practical purposes for which the composition is to be used.

A NEW MILITARY TELEGRAPH LINE.—The Signal Service, U.S.A., has just completed a transcontinental military telegraph line from Bismarck, Dacotah, to Dayton, Washington Territory. It crosses the rocky mountains by the Sohm Pass over the Mullan Road.

AN electric railway between Lichterfelde and Tettow, with a branch line to Grosse Kadettenhaus, is now being constructed by Messrs. Siemens and Halske of Berlin.

EDISON'S original lamp, with the carbon loop, is now in the South Kensington Museum (the Patent Museum). It is accompanied by a certificate from Mr. Edison stating that it burned for 1,390 hours.

SWAN'S electric lamps have been fitted up by Mr. Stearn, of Rock Ferry, Liverpool, in his residence.

REYNIER'S BATTERY.—The solutions which it is best to employ in this battery are, according to the patent specification, No. 1234, as follows:—Water, 1,200 parts by weight; soda, 300; potash, 100; chlorate of potash, 20; chlorate of soda, 20; chloride of potassium, 20; chloride of sodium, 20; sulphate of potash, 20; sulphate of soda, 20; the zinc plate is immersed in this solution. The depolarising liquid in which the copper plate is immersed should be as follows:—Water, 1,200 parts by weight; sulphate of copper, 240; nitrate of copper, 60; chlorate of potash, 20; chlorate of soda, 20; chloride of potassium, 20; chloride of sodium, 20; chloride of zinc (saturated solution), 20;

sulphate of potash, 20; sulphate of soda, 20; sulphate of zinc, 20.

EXPERIMENTS by Forbes in 1831, and by some others since, seemed to warrant the view, now commonly held, that the metals fall into the same series as regards conduction of electricity and conduction of heat, that the quotient of the heat conductivity by electric conductivity is nearly constant. Herr H. F. Weber, inclined to doubt this as contradicting the view (proved for gases and liquids) that the amount of heat transferred within a substance from layer to layer is most intimately connected with the specific heat of unit volume, made new experiments in this relation (which he has described to the Berlin Academy). He measured the heat-conduction by observing the cooling of various metal rings in a space at constant temperature, and the electric conducting power of the same rings by noting their deadening effect on the oscillations of a magnet. The result confirmed his anticipations, the quotient of heat-conduction by electric conduction being found in the closest connection with the specific heat of unit volume. Experiments by a different electrical method for metals conducting electricity badly (lead, bismuth, &c.), and for mercury gave the same result. (Ten metals in all were examined.) On the other hand, non-metallic conductors of electricity do not show the relation in question, *e.g.*, the heat-conduction of carbon is at least twenty to thirty times greater than that calculated from the electric conductivity and the specific heat. Thus the relation seems to be connected with the metallic nature of the substance. Herr Weber found the heat-conducting power of all the solid metals examined to decrease with increasing temperature, but at a considerably less rate than the electric conductivity. He further offers explanations of the erroneous view adopted, noting, *inter alia*, that the experiments in one case, though exact, were on too few metals, and these had nearly the same specific heat.—*Nature.*

PERRY AND AYRTON'S DISPERSION PHOTOMETER.—This instrument, which is peculiarly adapted for comparing powerful lights with the standard candle, is now manufactured and sold by Messrs. Latimer, Clark, Muirhead and Co. The principle of construction is that of weakening the light to be measured by illuminating a screen at a great distance from the source; the same effect is produced by passing the light through a lens. It is evident that with the use of a lens a space of only a few feet will suffice for the measurement of a powerful electric light.

IN a letter to the *Operator*, Mr. T. D. Lockwood discusses the right of Mr. Berliner to the credit for having been the first to invent an instrument identical in principle with the microphone of Professor Hughes. He says that on April 14th, 1877, Mr. Berliner filed a caveat in the patent office at Washington, describing the contact telephone, or microphone. On April 27th, 1877, Mr. Edison filed an application in the patent office on his battery transmitter. On June 4th, 1877, Mr. Berliner filed his application in the patent office for a patent on the same invention previously described in his caveat of April 14th, 1877. In December, 1877, Mr. Hughes commenced his experiments; privately exhibited his microphone in January, 1878; and gave his perfected invention to the public in May, 1878.

THE subjoined Fleet circular has been issued by the Admiralty:—"My Lords Commissioners of the Admiralty are pleased to direct that in future the captains and commanding officers of Her Majesty's ships and vessels are to be held responsible for ascertaining that the continuity of the lightning-conductors on board the ships and vessels under their command is complete, and also for maintaining such lightning-conductors in a state of efficiency. In ships which have galvanometers on board the conductors are to be tested periodically, and in ships which are not supplied with such instruments the commanding officer is to apply for the conductors to be tested, when an opportunity offers, at a dockyard."

MR. HARRY S. FOSTER (of the firm of Foster, Hight, and Co., Copthall Buildings) has been appointed liquidator of the Electric Carbon Company, Limited.

THE PHOTOPHONE.—Professor Graham Bell has promised to read a paper before the Society of Arts upon his "Photophone" at the ordinary meeting on Wednesday, December 1st. As considerable interest is likely to attach to this paper, it is announced that only members of the Society can be admitted, and that they will be required to provide themselves with special tickets issued for the occasion.

M. JANSSEN has placed all the instruments in the observatory at Meudon, near Paris, at the disposal of Professor Bell, for the purpose of determining if the photophone is applicable to a study of the sounds which are supposed to occur on the surface of the sun.

MR. JOHN TROWBRIDGE, of Harvard University, Cambridge, Mass., has published some very interesting results respecting the behaviour of the earth's surface as a conductor of electricity, and its capacity for transmitting electric signals without the aid of a conducting wire. The experiments were made between Boston and Cambridge. It is stated that, on completing the circuit through a telephone and the ground, the existence of an electric current was plainly apparent from the ticking which the making and breaking of the circuit produced in the telephone, and that the time signals of the observatory clock were distinctly heard. Mr. Trowbridge concludes that theoretically it is possible without a cable to telegraph across the Atlantic Ocean. Apropos of these experiments, we may remark that a patent (No. 1909) was taken out in 1853 by G. E. Dering, for a method of telegraphing across water without wires, and a mode of uniting Great Britain and America by means of wires from the Land's End to the Giant's Causeway and Longerside in America. A patent (No. 1242) for effecting a similar object was taken out in 1854 by Mr. J. B. Lindsay.

MR. VAN CHOATE'S idea of relaying the Atlantic Cables, by means of a relay in mid-ocean, was anticipated by a patent (No. 156) taken out by four *ladies* in the year 1865.

AT the last meeting of the Edinburgh Town Council notice of motion was given, that it be remitted to the Lord Provost's Committee, with powers to order the removal of such telephone wires throughout the city as endanger or inconvenience the public, and to take such steps to prevent the future erection of such wires without authority.

THE large and commodious premises which have been for a considerable time in the course of erection for the Edinburgh Stock Exchange are rapidly approaching completion, and it is expected will be occupied before Christmas. The present Exchange is in direct telegraphic communication with the London and Glasgow Stock Exchanges, and with the Edinburgh General Post Office. Owing, however, to the great amount of business which is now transacted these arrangements are inadequate, and strenuous efforts are

being made to obtain an additional London wire, and for the establishment of direct communication with the Liverpool and Manchester Exchanges.

WE hear that Mr. Brockie has slightly modified the clutch of his lamp as described in our issue, No. 172, p. 114. We had the pleasure of seeing the modified form in use the other evening, and were much gratified at its behaviour. This lamp is admirably adapted by its simplicity for lighting large spaces, as the service of an attendant for regulating it, when once adjusted, is entirely unnecessary.

Correspondence.

THE TELEPHONE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—While working with a Gower-Bell telephone and a Crossley transmitter and Bell receiver in circuit it was observed that when speaking on the "Gower" the sounds always proceeded from the Bell receiver, and when speaking on the Crossley transmitter from the "Gower" with very marked improvement in distinctness.

Moving the Bell receiver when speaking on the Gower, or the Gower when speaking on the Crossley, gradually from the ear, when a distance of three-quarters of an inch intervened the sound began to move round to the other telephone, and when the distance was increased to an inch and a half the sound passed entirely into the other telephone.

On connecting an astatic galvanometer, the best at hand, in circuit with the Gower, and blowing with sufficient force to produce a clear sound on the whistle, the needle was deflected through 40 divisions. Increasing the blowing force until a deep sound was produced, the needle returned to zero, and passed through 10 divisions in the opposite direction.

The effects obtained when the blowing was at the distant station were similar but less marked, the deflections being 15 and 5 divisions respectively.

The figures given are the averages of several trials.

I am, Sir,
Yours faithfully,
Edinburgh. F. MACRAE KEITH.

MAGNETIC STORM.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The "magnetic storm" in connection with the display of aurora borealis of September 12th, mentioned in your issue of the 1st ult., was felt in full force in this part of South America.

The earth currents observed on the Rio Grande do Sul, Monte Video section of the Western and Brazilian Company's cables, were the strongest I remember ever having seen. The rapidity with which they changed direction, from positive to negative, and *vice versâ*, was simply astounding, and prevented measurements being taken.

Traffic was entirely suspended from 9.0 a.m. to 1.35 p.m., Rio de Janeiro time, and during the remainder of the day we experienced the greatest difficulty in working. The following quotations are from the Monte Video and Rio Grande diaries.

From Monte Video Diary.

"August 12th, 1880. 9.0 a.m. to 1.30 p.m. Unable to work. Earth currents too strong. 1.35 to 9.0 p.m. Earth currents greatly moderated, but still powerful, and working with greatest difficulty."

From Rio Grande Diary.

"August 12th, 1880. 9.5 till 1.35. Unable to keep spot on scale. Earth currents. Been trying to work to Monte Video, but impossible to keep light on scale. He says something about earth currents, and is unable to read."

I inclose you three cuttings from our slip, these being the only marks we managed to get on the tape for some three or four hours, owing to the coil being jammed first in one direction and then the other, more rapidly than we could adjust for.

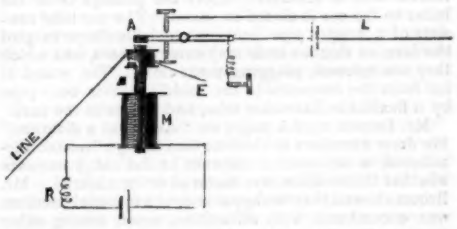
I understand the River Plate Company also experienced great difficulty in working between Monte Video and Buenos Ayres (Morse circuit), during the greater portion of the day, owing to very powerful "deflections."

I am, Sir,
Yours faithfully,
Monte Video, W. F. NOSWORTHY.
October 18th, 1880.

VYLE'S RELAY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your last issue, November 15th, a description is given of a new form of relay, invented by Mr. C. C. Vyle, of the Postal Telegraph Department, the idea conveyed being that this form is quite original. Will you allow me to point out that this is scarcely correct, as two years ago I constructed a relay on the same principle, and worked it on two circuits of 300 and 500 miles respectively, where, for a roughly-made apparatus, it worked exceedingly well, both single and double current. I may mention that the receiving coil was a small one of not more than 50 ohms resistance, showing the extreme sensitiveness of this system. I beg to attach sectional view of the relay, the only distinction between this and Mr. Vyle's being the substitution of electro for permanent magnet.



A. Soft iron. R. Resistance in current of electro-magnet, M. L. Local circuit.

I am, Sir,
Yours truly,
22, Athelstane Road, W. BOLTON.
N. Bow, E.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In reference to your article on "A New Relay," page 378, vol. viii., it may not be uninteresting to your readers to know that a direct double current sounder on this principle was introduced here by the chief mechanic and myself in 1873, and placed on trial for some weeks on several important circuits, giving good results.

The idea was suggested by observing the effect of contact on the Hughes instrument by

Yours respectfully,

Postal Telegraphs, FRED. T. BROWN.
Birmingham, Nov. 27, 1880.

E. PAGE.—The inducing magnets of a Siemens machine are usually wound with about No. 12 wire, and the induced magnets with about No. 14; but these sizes vary according to the work the machine is required to do. The Gramme is wound with similar wire. We are unable to say what wire is employed on the Wallace-Farmer electric light machines and the Weston plating machine, but perhaps one of our correspondents can inform you. The wires are merely insulated with cotton.

Proceedings of Societies.

THE PHYSICAL SOCIETY.—Nov. 13, 1880.

MR. BOSANQUET, of St. John's College Physical Laboratory, Cambridge, read a paper on "The Nature of the Sounds which Occur in the Beats of Consonance." From sustained octaves and twelfths he found that, when the beats of the harmonies are cleared away, each beat consists entirely of variations in the intensity of the lower notes. He gave the mathematical theory of these beats, and likewise of the curves given by the harmonograph. He also described an ear tube for using in connection with a resonator. It is difficult to get definite results with a resonator unless the passage from the latter to the ear is closed to sound. The ear tube consists of a copper pipe bent into a sickle shape to gird the face, so that the ends may enter the ears, into which they are screwed, plugging them close. The sound is led from the resonator to the middle of this bent pipe by a flexible india-rubber tube, and thence to the ears.

Mr. BROWN read a paper on "Action at a distance." He drew attention to the fact that though Newton disbelieved in action at a distance he did not pronounce whether the medium was material or immaterial. Mr. Brown showed that the hypothesis of a material medium was encumbered with difficulties, since, among other reasons, direct contact could not explain gravity; projection of small particles from one body to another could not explain attraction; and Le Sage's theory of corpuscles (as modified by Mr. Solver Preston) required an enormous degree of porosity in masses of matter. The nature of magnetism and vibration was also discussed by the author.

Mr. J. MACFARLANE GRAY read a paper on "The Mechanical Nature of the Forces called Attractions," and gave grounds for attributing them to the pressure of a universal material ether of a gaseous nature.

Profs. W. E. AYRTON and J. PERRY read a paper on "A Note on Exner's Papers on Contact Electricity." Assuming that the heat of combustion, due to the chemical actions going on in a cell, represents the E.M.F., Exner states that the difference of potential between zinc and its oxide, which he calls 2 E, is measured by the heat due to oxidation of zinc. If a non-oxidisable metal, say platinum, is brought into metallic connection with the zinc, the platinum takes art of the charge of the zinc, and the difference of potential between the platinum and the oxide of zinc becomes E. And from this it follows that the difference of potential between two metals in contact in air is measured by half the difference of their heats of combustion in oxygen. To show that his reasoning is correct, Exner has made experiments on three contact differences of potential, which agree very remarkably with the theory. But if the statement agrees with experiment, Messrs. Ayrton and Perry showed that it might be regarded as a most important empirical law; but experiments of Kohlrausch, Hankel, and the authors show that the empirical law does not hold. The authors then take up Exner's crucial experiment, to show that two plates of silver, one in an atmosphere of chlorine and the other in an atmosphere of oxygen, but in metallic connection with one another, show a difference of potential. They point out that if this experiment had been properly performed it would have corroborated the result arrived at by Mr. Brown of Belfast, which in no way contradicts the contact theory.

The authors point out that Exner's statement as to what the contact theory requires in a Smee cell is quite gratuitous, and indicates that he is not at all acquainted with the contact theory.

The authors incidentally referred to the complete disproof of the results of Exner's experiment on thermo-electricity given lately by Professor Young, of Princeton.

Professor MINCHIN, of Cooper's Hill Engineering College, exhibited a new "Photo-electric cell." This consists of a vessel of water containing a little acid, carbonate of calcium and two tinfoil plates. When a beam of lime light was allowed to fall on one of the plates a powerful current was set up in the cell, as seen by the deflection of a galvanometer connected in circuit with the plates. When a red glass screen intercepted the beam the effect was very slight. Professor Minchin had begun his experiments with fluorescence, but found "hard" water containing this salt of lime does equally well. The cell possesses this advantage, that the current it gives soon decreases in the light. When first the light falls on it the exposed plate is positive, but it soon changes to negative. Professor Minchin had tried the cell in place of a selenium one in the photophone, but with unsatisfactory results.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AN ordinary general meeting of this Society was held on Wednesday, Nov. 24th, Mr. W. H. PREECE, president, in the chair. The minutes of the last general meeting having been read and confirmed, the President announced that at a meeting of the Ronald trustees it was unanimously agreed that the Society of Telegraph Engineers had fulfilled the conditions upon which the Ronald's library was to be held by the Society. On the 22nd a general meeting would be held on which regulations for opening the library to the public would be considered.

Mr. J. W. SWAN then read a paper on "A system of sub-dividing the Electric Light."

Mr. SWAN first referred to arc lighting and lighting by the heating of carbon rods by the passage of the current, and stated that theoretically a light produced by the latter system was above all others very good. The electric light is unquestionably economical when concentrated, but possesses great mechanical defects. The arc light is not of much use for small lights, not being economical.

Several systems of lighting by incandescence have been stated to have been successful, but such has not really been the case. Definite numerical data are wanting on the subject, since mere impressions are not sufficient to guide any one.

Arc lights have never been properly measured. The Glasgow competition, which is the only case where

trustworthy measurements have been made, did not have a sufficient number of competitors to be of much value. Crompton's lamp, however, was thoroughly tested there.

The arc light, Mr. Swan repeated, is not economical except in special cases, as, for example, the Albert Hall, the British Museum, and St. Enoch's Station, Glasgow, where a few large lights are used only.

When a large number of lights are used, the consumption of a large number of carbons, and the loss of light by the sub-division, makes a very material difference; this is particularly noticeable on the Thames Embankment.

In estimating the light given by one or more lamps, the light obtained at every part of the space illuminated must be considered. A disadvantage of employing large lights is that when one is close up to it it gives too much light, and when far off too little. Mr. Swan considered that the arc light system would have to be abandoned, as it could not be sub-divided without loss.

The principle of incandescence is the only economical one, as by it subdivision can be effected without loss; this is proved by Faraday's laws, as a definite amount of current will produce the same amount of heat in one inch as in a hundred inches of wire. Theory, therefore, is in favour of incandescence.

Many materials have been tried for incandescent lamps, viz., platinum, iridium, and carbon. The metals, however, fuse at a high temperature. Mr. Swan then alluded to Edison's experiments with platinum wire.

Carbon was used in an incandescent lamp by King in 1845. In Werdermann's, Reynier, and André's lamps the consumption of the carbon does not affect the system, and they cannot, therefore, be said to be incandescent lamps exactly.

If it is required to prevent the combustion of the carbon, the latter must be placed in vessels exhausted of air, or else filled with nitrogen or other similar gas. The Sawyer-Mann lamp is of this description. Mr. Swan stated that in all his experiments he had dealt exclusively with a vacuum. This method would seem more difficult than the former, but certain difficulties cropped up when an incombustible gas had to be dealt with which did not occur in the case of a vacuum. Thus attrition of the carbon took place from the action of the particles of gas moving about.

Three causes existed which made incandescent lamps failures—1st, the carbon being too thick; 2nd, the carbon not being durable; 3rd, the obscuration of the glass globe in which the carbon was placed from a deposition of carbon particles on the side.

Mr. Swan held the opinion that the incandescent light was the light of the future.

Carbonised paper was tried by Mr. Swan 20 years ago, the first experiments being made with a 10-cell Callan battery and a *ringlet* of carbon, but no effect could be obtained. A horse-shoe of carbonised paper one inch high and one inch broad was subsequently tried, and with 50 Callan cells a bright red heat was obtained. Having no greater battery power at his disposal, Mr. Swan was unable to carry his experiments further.

The introduction of dynamo-electric machines and of the Sprengel air-pump enabled Mr. Swan to pursue his experiments with more success, and in these experiments great assistance was given by Mr. Stearn, of Birkenhead, who was skilled in the use of the Sprengel air-pump.

The disintegration of the carbon was the chief difficulty to be got over. Although tolerably good results were obtained with carbonised paper, a new material was at length found which gave much better results. This material was steel-like in its elasticity, and for Mr. Swan's purpose was in the form of wire $\frac{1}{100}$ of an inch thick. The hardness of the material was found to increase by use.

In the experiments the light was obtained by a current of about one weber, the resistance of the carbon filament being when cold about 150 ohms. The best current to be employed had not been yet ascertained, but one weber would give about 60 candle-power, the electro-motive force of the current being about 100 volts. Sixteen lamps were tried in Sir William Armstrong's residence with full power, and a magnificent light was obtained. It was not safe, however, to heat the carbon too much, as its durability would probably be impaired. If the light given by each lamp does not exceed 30 candles, there is no doubt but that the lamps will last for several months at least, and it is probable that even 60 candle-power could be obtained without damage.

Although for short distances the lamps might be joined up in multiple arc, for long distances they would require to be joined up in series. There would be no difficulty in varying the current according to the number of lamps joined in the circuit.

With regard to the supersession of gas light by the electric light, the question of durability of the lamps had yet to be determined; but even if the electric light became a complete success, Mr. Swan did not think that gas would suffer even if it did not gain. In concluding, Mr. Swan expressed his thanks to Mr. Ward of the British Electric Light Company for the assistance given in providing the current for working the lamps.

In the discussion which followed the reading of Mr. Swan's paper—

Mr. CROMPTON stated that in his experience small arc lights are less economical than gas, but that large arc lights are more economical. He drew attention to a curious fact in Mr. Swan's lamps, viz., that by reducing the length of the carbon filament from $1\frac{1}{2}$ to $\frac{1}{4}$ of an inch the light was increased five-fold. Mr. Crompton considered that the public would not be satisfied unless for a definite amount of money a very considerable increase of light was obtained by the electric over the gas light if the latter was to be superseded. Arc lights he did not think would come into collision with incandescent lights, as each had their special uses.

Dr. HOPKINSON said that small arc lights were not necessarily wanting in economy if 3 millimetre carbons were used; but small lights should be produced by direct and not alternating currents.

Mr. A. SIEMENS considered that large arc lights were necessary in illuminating large spaces, and that small lights did not give good effect. He did not consider that gas would be dispensed with, as it would always have a use for other purposes than lighting.

Mr. BERLY thought that small lights would come into extensive use. There was no reason why gas light should not be concentrated in lighting large spaces.

Professor TYNDALL congratulated Mr. Swan upon the success he had obtained. He considered the problem of lighting by incandescence as almost completely solved. The light might, he thought, be adopted with great advantage in coal mines.

Mr. SHOOLBRED pointed out that the arc lights gave a power of 550 candles per horse-power, and he doubted whether Mr. Swan obtained nearly that value with his system.

Professor AYRTON calculated that a current of 1 weber and a resistance of 150 ohms in each lamp represented an amount of energy expended equal to twenty times that required in an arc lamp for the same amount of light, and, therefore, if Mr. Swan's lamp is twice as

economical as gas, how much more economical is the arc light.

Mr. MOULTON inquired whether the adjustments, &c., of Mr. Swan's lamp were beyond the attainment of domestic servants, and he pointed out that this question had an important bearing upon its general adoption.

Mr. C. F. VARLEY pointed out that the resistance of the lamp (150 ohms) was the resistance of the cold carbon, and that when the latter was heated the resistance would change very considerably. He suggested that the vapour of an undecomposable metal might be tried in the lamp. The value of the light compared with the standard candle was, he pointed out, fallacious as usually estimated as the question of colour came into play.

Mr. SWAN, in reply to the queries, stated that as regards durability he had had a lamp burning continuously since August 8th, except for an interval of three weeks. His carbon patents would shortly be published, and the secret of the method of preparation would then become public. He showed that his lamps could be replaced with the greatest ease if required. He did not pretend that his system was the most economical possible, though it was cheaper than gas; he could obtain 150 candles per horse-power, which he contended was a good result. With regard to the use of the lamp in coal mines, he thought that the time was not ripe at present for the experiment.

A vote of thanks to Mr. Swan having been proposed by Sir CHARLES BRIGHT, and seconded by Mr. LATIMER CLARK, was carried unanimously. A vote of thanks was also passed to the British Electric Light Company for their disinterested assistance. The meeting then adjourned.

New Patents—1880.

4608. "Improvements in the means and apparatus for generating, sub-dividing, and transmitting electric currents, also in electric lamps." C. F. HEINRICHS. Dated November 9.

4614. "Electric lamps." C. W. SIEMENS. Dated November 10.

4621. "Magneto-electric signal apparatus." E. G. BREWER. (Communicated by E. H. Johnson and T. A. Edison.) Dated November 10.

4628. "Step by step type-printing telegraphs." F. H. W. HIGGINS. Dated November 10.

4674. "Telegraph cables." R. KENDAL. Dated November 13.

4739. "Electric batteries." H. E. NEWTON. (Communicated by L. A. W. Desrouelles.) Dated November 17.

4745. "Electric lamps." J. E. H. GORDON. Dated November 17.

4755. "Electric lamps and apparatus connected therewith." J. A. BERLY and D. HULETT. Dated November 18.

4779. "An improved electro-magnetic apparatus for table-services, offices, and warehouses." F. HARMANT. Dated November 19.

4825. "Dynamo-electric motors." C. KESSLER. (Communicated by E. Kuhls.) Dated November 22.

4850. "Improvements on switches and apparatus for use upon telephone lines." S. PITT. (Communicated by C. D. Haskins.) Dated November 23. *Complete.*

4862. "Telephones." S. PITT. (Communicated by C. de Nottbeck.) Dated November 23.

4866. "Electric lighting apparatus (electro-magnet)." W. R. LAKE. (Communicated by H. S. Maxim.) Dated November 23. *Complete.*

4886. "Dynamo-electric machines and lamps for electric lighting." J. HOPKINSON and A. MUIRHEAD. Dated November 24.

4887. "Speaking tubes and electric bells for use with the same, applicable also for other purposes." G. JENNINGS and E. G. BREWER. Dated November 24.

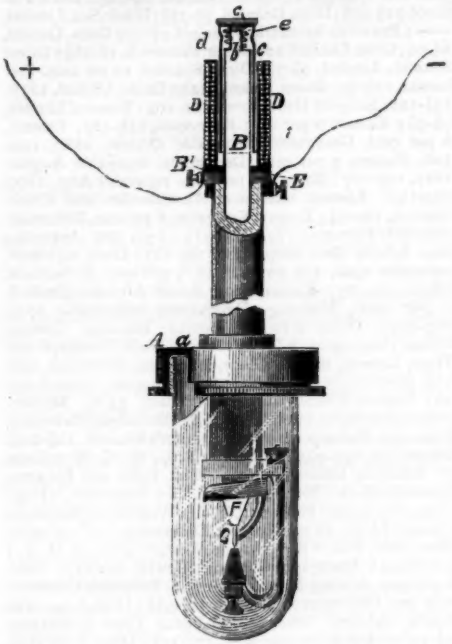
4914. "Electric light apparatus." W. L. WISE. (Communicated by J. A. Mandon.) Dated November 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

1385. "Dynamo or magneto-electric machines and electric motors." THOMAS ALVA EDISON. Dated April 5. 6d. Relates to the rotating armatures, the arrangement of the commutator brushes or contacts, and the shaft of the rotating armature and commutator, which are applicable to both dynamo or magneto-electric machines and to electric motors. The armature is constructed of a number of very thin discs or rings secured together upon a proper shaft or base, and slightly insulated from each other. The brushes or springs are set at an angle of about 30° to the axis of the commutator. When a breakage of the circuit is required it is done at several points simultaneously, so that the spark at the rupture is spread over several points, and does not burn up the contacts.

1507. "Electric lamps." G. G. ANDRÉ. Dated April 13. 6d. In electric lamps in which a stick of carbon is made to "burn" in a closed vessel or globe, the atmosphere contained therein, when the light is turned out by the current being cut off, consists of carbonic oxide and nitrogen. Owing to practical difficulties, in the way of making joints, it is generally found that the atmospheric air, while the lamp cools down, slowly enters the globe, and the atmosphere therein then consists of carbonic oxide mixed with oxygen and nitrogen, forming an inflammable mixture which, when the lamp is relit causes an explosion and a destruction of the globe, and sometimes also the interior parts of the lamps. The objects of this invention are to prevent the above evil, to regulate the consumption of the carbon as desired, and, as regards carbon lamps working by incandescence, to preserve the point of the carbon. A small hole, *a*, is provided through the sole or cover plate, A, of the lamp, and the size of this hole is such as to supply the incandescent carbon with a small quantity of air sufficient to preserve its form, and to burn the carbon dust thrown off, or nearly so. This aperture may, if desired, be made adjustable by being increased in size, and fitted with a somewhat conical screw, or one having one or more taper flats, which are broadest at the end filed on it (like a tap for forming screw thread in nuts), or in any other suitable and well known manner. The tube, B, for the carbon and the weight resting thereon is narrowed at the top at *b*. C is an iron cap or tube valve, which is free to slide on the tube, *b*; it has a leather washer, *c*, inside the top, and has one or more holes at *d*; the cap tube, C, forms a solenoid core inside the coil, D, which rests on the flange, B^1, on the tube, B; E is an insulating washer. As long as the current is on, and the lamp burning, the core tube, C, is drawn down, and the leather washer, *c*, then rests on the top of the tube part, *b*, preventing air escape or entry at this place, but as soon as the lamp goes out, the current ceasing,

the least pressure inside the lamp globe or cylinder will raise the cap tube or valve, C, and such pressure will then be relieved, and a current established by the hole, *a*, and the holes, *d*. The possibility of an explosion is



thus prevented; *e* is a helical spring for raising the cap tube, or valve, C, when the electric current ceases.

1510. "Insulators." A. GILBERT, G. WELLS. Dated April 13. 4d. The invention has for its

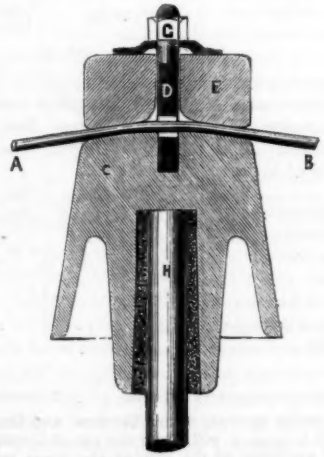


FIG. 1.

object the production of an insulator so constructed as, without affecting the insulation, to secure the wire, so that, in the event of the wire breaking between any two posts, the other parts of the wire on the other sides of the posts between which the breakage occurs shall remain securely held as before. Fig. 1. represents a section taken through the insulator in a line with the wire; fig. 2, a transverse section. The insulator proper is of the ordinary bell shape. The part, C, has embedded in it at the time of making a screw bolt, D, so that when the wire, after being properly strained, is laid in the groove made for its reception in the part, C,

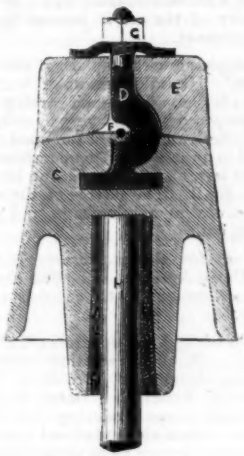


FIG. 2.

the cap, E, of the insulator, which has a corresponding groove, and through the centre of which the bolt, D, passes, is placed thereon, and by means of the nut, G, is brought to bear tightly upon the wire, F, which is thus rigidly held between the grooves in the insulator, C, and cap, E. The bolt, D, is made of the shape as shown in fig. 2, so as to allow of the wire being readily placed in or removed from the insulator, and at the same time to bring the pressure of the nut directly over the centre of the cap.

1511. "Telephone switches." JOHN HENRY JOHNSON. (A communication from abroad by Ernest Marx, Frank A. Klemm, and Julius Kayser, of New York.) Dated April 13. 6d. Relates to certain improvements in the construction of telephone switches. It has for its objects simplicity and economy in construction and absolute positiveness in operation, and, with these ends in view, the invention consists of a stationary hanger-post in combination with a vibratory bell crank lever and flat spring, so arranged in relation to the main line wire bell telephone and transmitter wire and local battery, that the presence of the telephone in position will positively connect the bell with the main line, and open the local circuit, and its removal for use will cut out the bell, close the local battery circuit, and put the telephone and transmitter on the line.

1552. "Electric lamps." ALEXANDER MELVILLE CLARKE. (A communication from abroad by Jean Marie Anatole Gérard-Lescuyer, of Paris.) Dated April 15. 6d. Relates to an improved arrangement of electric lamp or burner, which is distinguished from all others now in use by its simplicity, its great lighting

capacity in proportion to the expenditure of power, by the electrodes being automatically maintained at an invariable distance apart, whereby absolute fixity of the light is insured, and also by the length of time during which it will burn without attention. The chief improvement consists in the arrangement of the electrodes, which are each formed of two carbons inclined towards one another in the form of the letter V, and so shaped at their points as to meet and touch one another in a vertical plane passing through the axis of the apparatus. The two double electrodes are automatically maintained at a suitable distance apart by mechanism, while the fixity of the arc is insured by an electro-magnet arrangement.

1556. "Applying electro-plating and gilding to wood surfaces." HENRI ALEXANDER VICTOR WIRTH. Dated April 16. 2d. The wood carving intended to be plated is prepared by destroying by means of known acids the superficial molecules of the wood; the carving is then placed in an oven at a temperature of 200 degrees, more or less, and for a sufficient length of time to completely dry it. The surface of the wood is then covered with a coating of plumbago, and placed in an electro-plating bath.

1585. "Coils for electro-magnets, &c." GEORGE SCARLETT. Dated April 17. 6d. The electro-magnet is wound in sections, and all the sections are joined up for "quantity."

1649. "Electric lighting apparatus, &c." WILLIAM ROBERT LAKE. (A communication from abroad by Hiram Stevens Maxim, of Brooklyn, New York, United States of America.) Dated April 21. 8d. Relates to electric lamps producing light by a voltaic arc between two carbon electrodes, and especially to the class of such lamps known as hanging lamps, in which the clockwork or other machinery for feeding the carbons is located in a case above the focus; and an improved method of regulating such feeding mechanism; and an improved construction of the part of the lamp carrying the lower carbon and the globe.

1751. "Electric signal apparatus for railroads." WILLIAM MORGAN-BROWN. (A communication from abroad by Oscar Gassett, of Boston, Massachusetts, United States of America.) Dated April 29. 1s. Relates to electric signal apparatus for railroads, used in connection with that class of apparatus operating with a closed circuit in which the signals are operated by shunting or short-circuiting their controlling electro-magnets by the wheels and axles of a train or otherwise, the battery circuit remaining constant except when accidentally broken, as by the breaking of a rail or washing out of the track, or rupture of a wire or otherwise.

THE ANGLO-AMERICAN TELEGRAPH COMPANY'S Brest and St. Pierre Cable was reported broken on the morning of the 12th ultimo, at a distance of about 230 miles from Brest. The s.s. *Scotia* was ordered to proceed to effect repairs as soon as she could be got ready. It will be remembered by most of our readers that the Anglo Company has somewhat recently raised its tariff from 6d. to 2s. per word, except on the above-mentioned cable, as on this line of communication the French Government has some control by virtue of the landing concession, and it objected to the rate being again raised. Some people on this side regard the reported break, therefore, as a curious coincidence, and even go so far as to hint that the cable was purposely broken. We cannot, however, endorse this opinion; the authorities of the Anglo Company have much too great business capacity to allow them to wilfully damage their own property. Such rumours are manifestly absurd.

The following are the final quotations of telegraphs for the 30th ult.:—Anglo-American Limited, 64-64½; Ditto, Preferred, 92½-93½; Ditto, Deferred, 35-35½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9¾-10; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16-16½; Direct Spanish, Limited, 2¾-3¼; Direct Spanish, 10 per cent. Preference, 12¼-13; Direct United States Cable, Limited, 1877, 12¼-12½; Scrip of Debentures, 102-104; Eastern, Limited, 9¼-9⅞; Eastern 6 per cent. Preference, 12¼-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 102-107; Eastern, 5 per cent., repayable Aug., 1899, 104-107; Eastern Extension, Australasian and China, Limited, 10-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 105-107; Ditto, registered, repayable 1900, 105-107; Ditto, 5 per cent. Debenture, 1890, 101-103; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 103-104; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 10-10⅛; Globe Telegraph and Trust, Limited, 6⅛-6¼; Globe, 6 per cent. Preference, 12⅛-12¾; Great Northern, 10⅞-11⅛; Indo-European, Limited, 25-26; London Platino-Brazilian, Limited, 5¼-6; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 10¾-11¼; Submarine, 255-265; Submarine Scrip, 2⅜-2⅝; West Coast of America, Limited, 3¼-3½; West India and Panama, Limited, 1⅝-2⅜; Ditto, 6 per cent. First Preference, 6¾-7¼; Ditto, ditto, Second Preference, 6¼-6⅝; Western and Brazilian, Limited, 8⅜-8¾; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 98-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 34¼-35¾; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3¾-4; India Rubber Company, 17¼-17⅜; Ditto 6 per cent. Debenture, 106-108.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	OCTOBER,		INCREASE OR DECREASE.
	1880.	1879.	
	£	£	£
Anglo-American.....	*	...	...
Brazilian Submarine ...	†16,620	†16,158	Inc. 462
Cuba Submarine	2,100	3,512	Dec. 1,412
Direct Spanish	1,821	1,370	Inc. 451
Direct United States ...	*	...	...
Eastern	47,570	50,251	Dec. 2,681
Eastern Extension	29,061	31,419	Dec. 2,358
Great Northern	22,480	...	...
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	‡11,572	...	...
West India	...	...	...

* Publication temporarily suspended. † Five weeks.

‡ The traffic receipts of the Western and Brazilian Telegraph Company will, from the 1st of October, be published exclusive of the fifth of the gross receipts payable to the London Platino and Brazilian Telegraph Company, Limited, which fifth has hitherto been included in the amounts published.